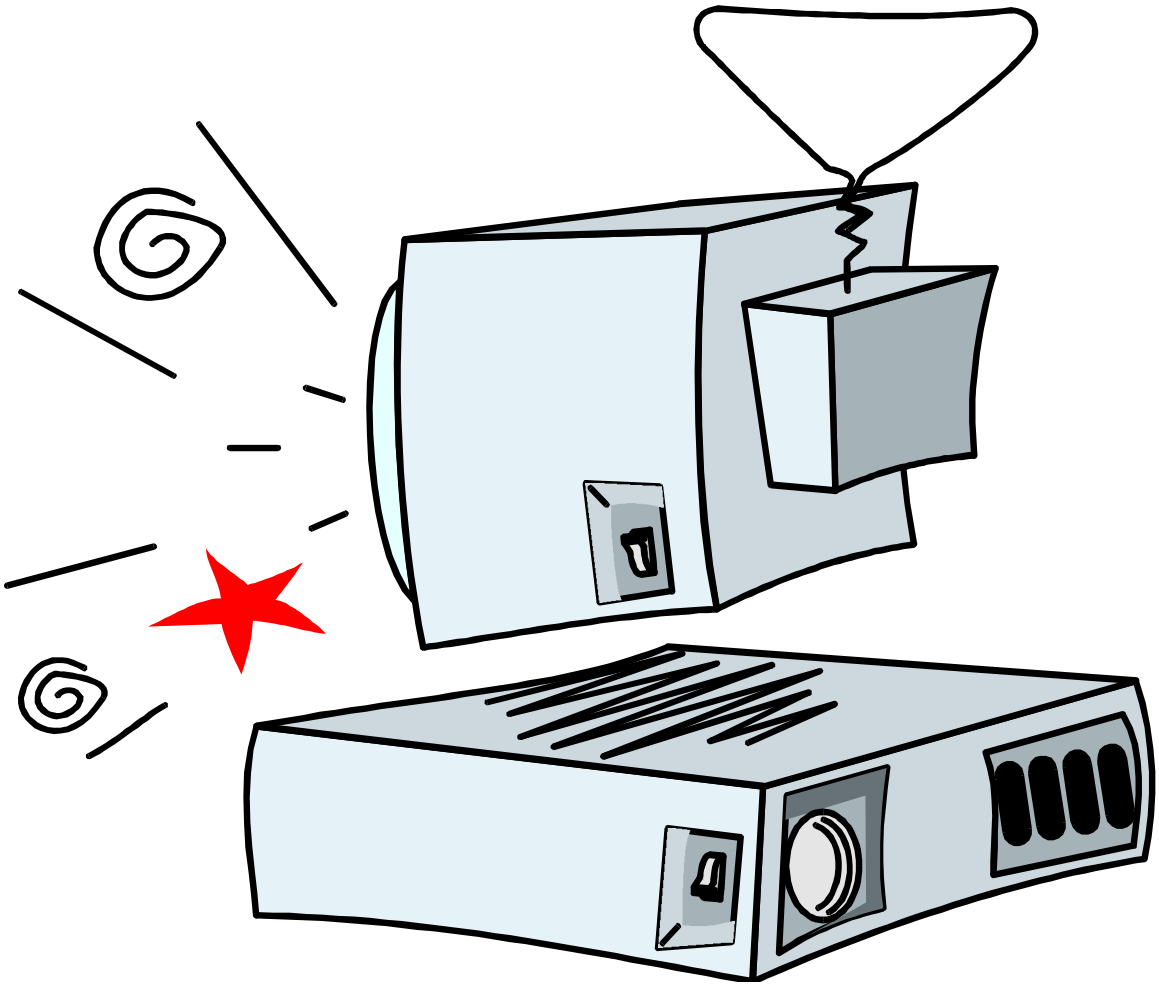
PC

troubleshooting



NATIONAL INSTITUTES OF HEALTH

DIVISION OF COMPUTER RESEARCH AND TECHNOLOGY

CUSTOMER SERVICES BRANCH

CONTENTS

Unit 5 Troubleshooting Pairs

Reference

UNIT I

HARDWARE COMPONENTS

"You can very successfully use a PC without really understanding it. However, the better you understand your PC, the better equipped you are to realize the potential in the machine and—let's not forget this—to deal with emergencies that might arise when working with a PC. After all, when something goes wrong in your PC, the better you understand the machine, the more likely you are to make the right moves to fix the problem, rather than err and make things worse." —Peter Norton

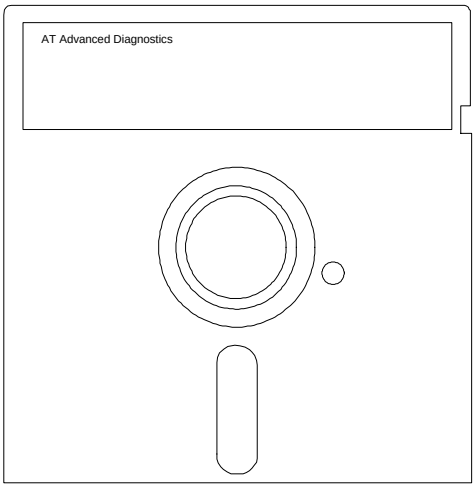
Objectives

At the conclusion of this unit, the student will be able to:

- document an existing system setup.
- follow important safety procedures in working with PC hardware.
- completely disassemble a system unit.
- identify individual components inside the system unit and describe their functions.
- define the different classes of PCs as determined by their processor.

Accessing the Setup

A microcomputer's setup information is stored in a specific chip on the system board called the CMOS. Occasionally, an error situation or an upgrade to the system will require that you correct or revise the configuration settings. **The procedure to access the setup varies on different types of PCs**. Some comuters use an advanced diagnostic diskette to modify the system setup. Other computers may require that a specific keystroke is pressed at startup to run the setup. Information on the setup routine for each PC can be found in the hardware manual.



To access Setup on the _____ PCs used in this class, press the keystroke sequence _____.

Exercise #1 - Documenting the System

1. Turn your computer on.

2. At the DOS prompt (C:\>) type ***msd*** and press ↵.

3. Using the information provided by the Microsoft Diagnostics (MSD) software, fill in the blanks on the following chart.

Computer ...	_____	**Disk Drives ...**	_____
Memory ...	_____	**LPT Ports ...**	_____
Video ...	_____	**COM Ports ...**	_____
Network ...	_____	**IRQ Status ...**	_____
OS Version ...	_____	**TSR Programs ...**	_____
Mouse ...	_____	**Device Drivers ...**	_____
Other Adapters ...	_____		

4. After you have completed the previous chart, type ***D*** to select Disk Drives. The Disk Drives screen appears.

5. Using the information provided, fill in the details listed for the drive type, free space and total size below.

Drive	Type	Free Space	Total Size
A:			
B:			
C:			

6. After you have completed documenting the disk details, hold down the **Alt** key and type ***F*** to access the File menu. The File menu appears.

7. Type ***X*** to select Exit. The DOS prompt appears.

The Troubleshooter Tool Kit

To troubleshoot and repair PC systems properly, you need the following basic tools:

- Simple hand tools for basic disassembly and reassembly procedures
- Wrap plugs for diagnosing port problems
- Meters for accurately measuring voltage and resistance

In addition, you might need soldering and desoldering tools for problems that require these operations.

Hand Tools

Following is a list of the basic tools you can find in any of the small PC toolkits sold for $30.

- 3/16-inch nut driver
- ¼-inch nut driver
- Small Phillips screwdriver
- Small flat blade screwdriver
- Medium Phillips screwdriver
- Medium flat blade screwdriver
- Chip extractor
- Chip inserter
- Tweezers
- Claw-type parts grabber
- T10 TORX driver
- T15 TORX driver

Personal Safety Precautions for Disassembly

Safety is a major responsibility for all class participants. Following the precautions below will ensure that no one is seriously injured.

1. Ensure that all jewelry (watches, rings, bracelets, necklaces, etc.) are removed before going near electrical equipment.

2. Make sure that all neckties, bows, scarves, etc., are tucked in your shirt/blouse.

3. Ensure that all equipment is turned off and unplugged at the source, not at the power supply (this leaves hot power cords dangling).

4. Know what fire extinguishers and first aid kits are available if needed. Do not use a class "B" fire extinguisher on a CRT. It will cause an implosion. Rule of thumb: Always use a class "C" fire extinguisher (dry-chem or halon).

5. Use the buddy system in class at all times.

6. Finally, take your time. Do not rush. Haste can cause major damage to the equipment as well as to yourself.

Other Disassembly Notes

1. Ground yourself before touching any components.

2. Use the right tool for the job.

3. Don't force anything. If something seems stuck, ask the instructor.

4. When unplugging cables (and especially when removing chips) try to rock them out as straight as possible to avoid bending pins.

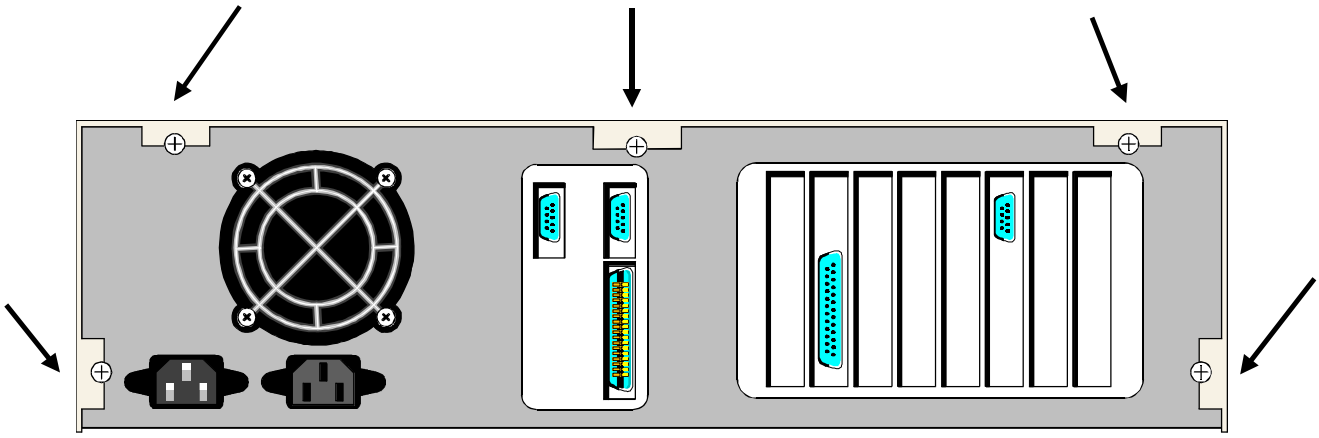
5. Take all the adapter boards out, but don't disassemble the boards themselves.

Exercise #2 - System Teardown (following demo)

1. Turn off the PC and disconnect the power cables.

2. Disconnect the monitor and carefully set it out of the way.

3. Remove the screws on the back of the system unit and place them in a secure location.



4. *Carefully* slide the case off the system unit, taking care not to snag any cables inside. Don't force anything. If you are having trouble, notify the instructor.

IMPORTANT: Before touching anything inside the chassis, touch the power supply unit to ground yourself. Develop a habit of always touching the power supply first before anything else to discharge any static electricity you may be carrying.

5. After the case has been removed, draw a *detailed* diagram of the contents inside the chassis. Use the space provided below.

Removing Components

Complete the following sequence to remove each of the individual components from the chassis.

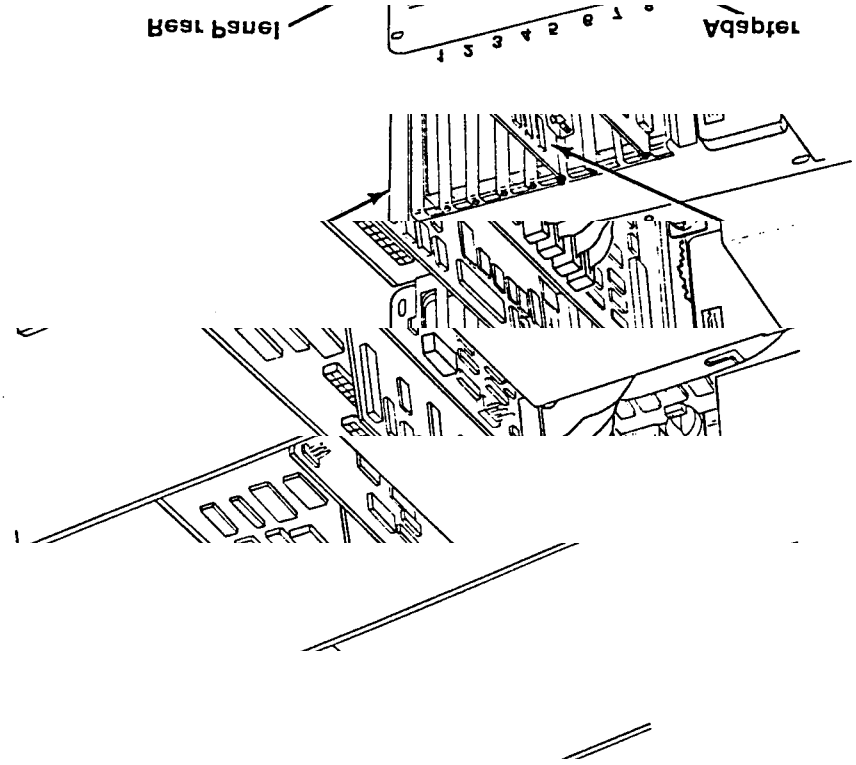
Adapter Boards

To remove all the adapter boards from the system unit, first remove the system unit cover as described previously and then perform the following *for each adapter*:

1. Note which slot the adapter is in. Make sure it appears on your drawing.

2. Use the 3/16-inch nut driver or flat screwdriver to remove the screw holding the adapter in place. Make sure to put the adapter screws in a secure location.

3. If any cables are plugged into the adapter, *note their positions* and remove them. The odd-colored stripe on one side of the ribbon cable always denotes pin number 1 in a correctly wired system.



4. Remove the adapter by lifting with even force at both ends.

5. If there are any jumpers or switches on the adapter, note their positions. Jumpers and switches normally are named on the circuit board (SW1 for switch 1, J1 for jumper 1, and so on). If necessary, make a diagram that shows these features of each particular card.

Adapters as Controllers

Each I/O device requires a *controller* to act as its supervisor and to interact with the processor. Some controllers have their own on-board processors, and some even have their own memory. The controller can be built either into the motherboard, the device it controls, or on a separate adapter that must be plugged into the bus (a slot).

Common Hard Disk Controllers

ST-506	Designed by Seagate for the original IBM PC, XT, and used in many ATs and compatibles.
ESDI	(Enhanced Small Disk Interface) Originated by Maxtor Corp. in 1983.
IDE	(Integrated Drive Electronics) Created by Compaq, based on the ST-506.
EIDE	(Extended Integrated Drive Electronics) An improved version of IDE with faster data transfer rates, 32 bit transactions and in some drives the ability to read and write to memory without intervention by the CPU.
SCSI	(Small Computer System Interface) Processor independent standard for system-level interfacing between a computer and intelligent devices including hard disks, floppy disks, CD ROMs, printers, scanners, and more.

Disk Drives

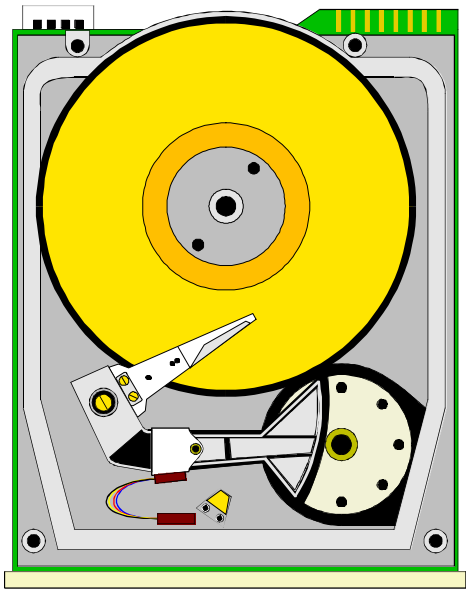
Removing drives from most systems is easy. The procedures are similar for both floppy and hard disk drives. Always back up hard disks completely and park the heads if necessary before removal from the system. The possibility always exists that data will be lost or the drive will be damaged from rough handling. To remove the drives from the system, follow these steps:

1. Depending on whether the drive is a hard disk or a floppy disk drive, it will be retained by a metal keeper bar with two screws or two small L-shaped metal tabs held in by a single screw each. Locate these screws and remove them, along with the tabs and keeper bar.

2. Slide the disk drive forward about two inches and disconnect the power cables, signal and data cables, and ground wire from the drives. The odd-colored stripe on one side of the ribbon cable always denotes pin number 1 in a correctly wired system. The power connector is shaped so that it can be inserted only the correct way.

3. Slide the drive completely out of the unit.

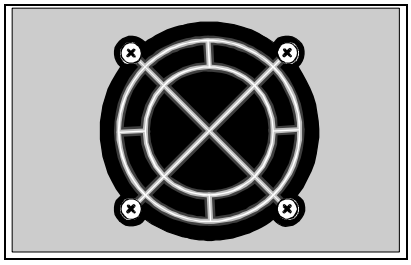
4. Remove the remaining disks in the same manner.



Power Supply

Although we will not remove the power supply for this exercise, it is easy to do.

In most systems, the power supply is mounted in the system unit with four screws in the rear and two interlocking tabs on the bottom. Removing the power supply is simple, but the procedure usually requires that either you remove the disk drives first, or at least slide the disk drives forward for clearance when removing the supply. To remove the power supply, complete the following:



1. Remove the four power-supply retaining screws from the rear of the system unit chassis.

2. Disconnect the cables from the power supply to the motherboard. Disconnect the cables from the power supply to the disk drives. Always grasp the connectors themselves; never pull on the wires.

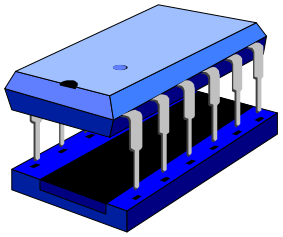
3. Slide the power supply forward about a half-inch to disengage the interlocking tabs on the bottom of the unit. Then lift the power supply out of the unit.

End of dissassembly.

Hardware Details (Discussion)

The Microprocessor

The microprocessor or central processing unit (CPU) is the "brain" of the PC and performs all the system's calculating and processing.



Locate the microprocessor. What did you use to identify it?

_____

_____

The Data Bus and the Address Bus

One of the most common ways to describe a microprocessor is the size of the processor's data bus and address bus. A bus is simply a series of connections designed to carry common signals. The data bus is used to send and receive information. The address bus is used for addressing information in memory.

Following are the bus sizes for the Intel (CISC) microprocessors used in IBM and compatible PCs:

Date of Announcement	Microprocessor	Alternative Name	Address Bus	Data Bus
June 1978	8086		16 bit	16 bit
February 1979	8088		16 bit	8 bit
February 1982	'286		16 bit	16 bit
March 1982	'186		16 bit	16 bit
March 1982	'188		16 bit	8 bit
October 1985	'386	'386 DX (D=double)	32 bit	32 bit
June 1988	'386 SX (S=single)		32 bit	16 bit
April 1989	'486 (386+co)	'486 DX	32 bit	32 bit
October 1990	'386 SL	for small laptop	32 bit	16 bit
April 1991	'486 SX (no co)		32 bit	32 bit
July 1993	Pentium	'586 class	64 bit	64 bit

The Coprocessor

Coprocessors extend the power of the main processor. They are primarily used to perform mathematical operations. For this reason, they are called math coprocessors.

Does your PC have a math coprocessor? _____

If it doesn't, what coprocessor could be added to your system? _____

The important thing to know is that the coprocessor must be matched correctly to the main processor. Following is a chart showing the main processor and its complementary coprocessor.

Processor	Math Coprocessor
8086	8087
8088	8087
'286	'287
'186	8087
'188	8087
'386	'387 SX
'386 SX (S=single)	'387 SX
'486 (386+co)	built-in
'386 SL	'387 SX
'486 SX (no co)	'487 SX - this chip is actually a full-function 486 chip with a functioning built-in coprocessor. Installing this chip will disable the '486SX chip.

Processor Speeds

Each microprocessor comes in more than one model or form. The difference in these models is that they run at different speeds. The following chart lists each microprocessor and the model speeds that were officially offered by Intel.

Microprocessor	Speeds in megahertz
8088	4.77, 8, 10
8086	4.77, 8, 10
'188	8, 10, 12.5, 16
'186	8, 10, 12.5, 16
'286	8, 10, 12.5
'386 SX	16, 20
'386 SL	20, 25
'386	12.5, 16, 20, 25, 33
'486 SX	20, 25
'486	25, 33, 50
Pentium	60, 66, 75, 90, 100, 120, 150, 166, 200

Types of Slots

Six basic types of slot designs are found in IBM and compatible systems today. These types are:

- The original PC and XT slot - 8 bit
  
- ISA (Industry Standard Architecture) - 16 bit
  
- MCA (Micro Channel Architecture) - 32 bit

- EISA (Extended Industry Standard Architecture) - 32 bit

The Local Bus

- VESA or VL (Video Electronics Standards Association) - 32 bit
  
- PCI (Peripheral Component Interconnect) - 32/64 bit
  

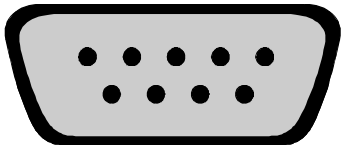
Plug and Play (P&P)

P&P adapters contain information on a ROM chip that identifies them and what type of memory and resources they need to work. PCs that are P&P ready contain a special BIOS to read the information supplied from the adapters and manage resource allocation without human intervention.

Communication Ports

The basic communications ports in any PC system are the serial and parallel ports. The serial ports are primarily used for devices that must communicate bidirectionally with the system; such devices include modems, mice, scanners, digitizers, or any other device that "talks" as well as receives information from the PC. The parallel ports are used primarily for printers and operate as one-way communications ports.

Serial Ports



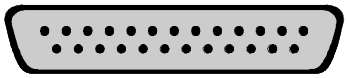
The asynchronous serial interface is the primary system-to-system communications device. *Asynchronous* means that no synchronization or clocking signal is present. Characters may be sent with any arbitrary time spacing. The intervals between characters may be completely irregular, as when a typist is providing the data.

Serial refers to data sent over one wire with each bit lining up in a series as they are sent in order. This type of communication is used over the phone system because this system provides one wire for data in each direction.

Serial ports may connect a variety of devices such as modems, plotters, printers, other computers, bar code readers, scales, device control circuits, and so on. Basically, anything that needs a two-way connection to the PC uses the industry-standard Reference Standard number 232 revision c (RS-232c) serial port. This device enables data transfer between otherwise incompatible devices. The most common uses for serial ports are to connect modems and printers.

Does your PC have a serial port? _____

Parallel Ports



A parallel port has eight lines for sending all the bits for one byte of data simultaneously across eight wires. This interface is fast and usually is reserved for printers rather than computer-to-computer communications. The only problem with parallel ports is that cables cannot be extended for any great length without amplification or introducing errors into the signal.

Does your PC have a parallel port? _____

The CPU and Memory

The architecture of the CPU (the microprocessor) has the final word on a computer's memory capacity.

- The 8088, with its 20 address lines, can keep track of and directly reference up to 1,024K, or 1M, of memory. The hardware design of the PC reserves the top 384K of that memory for special purposes, so you have access to 640K for your programs and data.

- The 80286 CPU in the AT has 24 address lines, so it can keep track of up to 16M of memory.

- The 80386 and 80486 CPU, used in the PS/2 Models 70-95 and many compatibles, has a full set of 32 address lines, which allow a staggering 4 gigabytes of memory.

The 80286 and 80386 each emulate the 8086 by implementing a hardware mode of operation called real mode. Under real mode, all Intel processors—even the Pentium—are restricted to using only 1M, and 384K of that is still reserved by the motherboard design. Only under the protected mode of operation can the 80286, 80386, 80486, and Pentium use their maximum potential for memory addressing.

Motherboard Memory

A system usually has some type of primary circuit board. As mentioned previously, most systems, such as those from IBM and compatibles, use a motherboard, which contains the aforementioned slots for expansion adapters. This primary circuit contains the system's processor and some amount of installed memory.

The advantage of memory installed directly on the motherboard is that, for many systems, access to this memory is faster than any memory accessed through an expansion slot. And even if you don't have any advantage in speed, you do have an advantage in the savings of slots. The more memory you can get on the motherboard, the fewer memory expansion adapters you need.

Locate the memory on your motherboard. How much is there? _____

UNIT 2

PREVENTATIVE MAINTENANCE TECHNIQUES

Microcomputers are generally very reliable. They were designed to take quite a bit of abuse and still perform flawlessly. However, they do need proper installation and configuration. And depending on the conditions and environment in which they are used, they will also need periodic or perhaps even daily care.

Objectives

At the conclusion of this unit, the student will be able to:

- clean the inside of a system unit.
- reseat chips.
- reassemble a computer.

Cleaning the System

One of the most important operations in a good preventive maintenance program is regular and thorough cleaning of the system. All IBM and compatible systems use a forced air cooling system; a fan is mounted in, on, or near the power supply and exhausts air to the outside. Because this fan is an exhaust fan, unfiltered outside air is drawn into every opening in the system chassis and cover.

In any system in which no filtration of the incoming cooling air occurs, dust builds up. Any cigarette smoke or other particulate or chemical matter that is in the environment also is drawn into the system and collects on everything. This dust and garbage buildup can cause severe problems in a system if allowed to go unchecked. The dust layer acts as an insulator to heat, which prevents proper cooling of the system and may cause a system to overheat and damage components. The dust may contain other chemicals such as those in cigarette smoke. These chemicals can conduct electricity, causing minor current shorts and electrical signal paths where they should not be. The chemicals also rapidly accelerate corrosion on any of the components in the system that are installed in sockets or where boards plug into slots. Cable connectors also can be affected by this corrosion.

Hard disk drives do not have the same problems with dust and dirt that floppy drives do, because the head disk assembly (HDA) in a hard disk is a completely sealed unit, and no dust or dirt can enter. Cleaning a hard disk means simply blowing off the dust and dirt from the outside of the drive. No internal cleaning can be performed.

Floppy disk drives are another story. Because these drives are directly in an incoming air path, they accumulate an amazing amount of garbage in a short time. Floppy drives are, after all, the source of a large "hole" in the system through which air is directly drawn in.

Cleaning Supplies and Equipment

To properly clean the system and all the boards inside, you need several items and tools. To clean your system, you usually must first disassemble most of it. Removing the motherboard does result in the best possible job, but in the interest of saving time, just make sure that you take the system apart at least to the point where the motherboard is completely visible.

Besides the tools that are required for you to disassemble the unit, you will need the following:

- Liquid Cleaning solution - The solution should contain freon, isopropyl alcohol, or some mixture of the two. Pure freon is probably the best, but it is expensive. The material must be moisture and residue free. The solution should be in liquid form—not a spray.

- Canned air - The canned air must be completely moisture and residue free and packaged specifically for computer use.

- A small brush - The brush can be a makeup brush or photography type of brush. You use the brush to loosen accumulated dirt and dust before blowing off this dirt with the canned air or vacuuming with the vacuum cleaner.

- Lint-free foam cleaning swabs - The cleaning swabs should be of the foam type, which do not leave any lint or dust residue of their own.

Optionally, you also may want to add the following:

- Silicone lubricant - You use pure silicone lubricant to lubricate the door mechanism on floppy disk drives. This lubricant also can be used to lubricate the head slider rails or printer head slider rails, allowing smooth operation. Using silicone rather than conventional oils is important because the silicone does not gum up and collect dust and other debris. Always use the silicone sparingly; do not simply spray it anywhere near the equipment. Instead, apply a small amount to a toothpick and dab it onto the disk drive components where needed.

- Computer vacuum cleaner - The vacuum cleaner is more useful in situations where you do not want to remove the motherboard completely from a system. You can use the vacuum cleaner to suck out the dust and debris, as opposed to simply blowing it all over the place as with the canned air.

- Antistatic wrist grounding strap - You may want to use a grounding strap in cases where the static levels are high, to ensure that you do not zap any boards as you work with them. Some of the cleaning operations may generate a static charge.

Reseating Socketed Chips

One of the primary preventive-maintenance functions is to undo the effects of "chip creep." As your system heats and cools, it also expands and contracts. This physical expansion and contraction causes any components plugged into sockets to gradually work their way out of those sockets. The idea is to make sure that all these socketed components are fully seated in their sockets.

You can do this by placing your hand on the underside of the board and then applying downward pressure with your thumb from the top side directly on the chip to be seated. For large chips, seat the chip in two operations: Press separately on each end of the chip with your thumb to be sure that the chip is fully seated. Sometimes, the force required can be quite high, but in most cases, you hear a crunching sound as the chip makes its way back into the socket.

Because of the high forces required for you to press the chips down, this operation is difficult if you do not remove the board. For motherboards, this operation can be quite dangerous if you don't support the board directly from the underside with your hand.

Exercise #3 - Cleaning Your Computer

Complete the following steps to clean your computer.

1. First clean the dust and debris off of the boards themselves and then clean any connectors on the boards. To clean the boards, first use the brush to gently wipe the boards, loosening and removing any dust and debris. Simply blasting a board with compressed air does not remove all the dirt and dust. After you loosen the debris with the brush, blow off the debris or vacuum it up. ***Caution: Be careful with static.*** Keep a finger or thumb on the ground of the motherboard or card as you wipe it off. If available, use one of the static grounding wrist straps, which should be connected to the ground of the card or board that you are wiping. The strap ensures that no electrical discharge occurs between you and the board.

2. On the motherboard, clean the slot connectors, power supply connectors, keyboard connector, speaker connector, and anything else you can find. For most plug-in cards, clean the edge connectors on the cards that plug into slots on the motherboard as well as any other connectors, such as external connectors mounted on the card bracket.

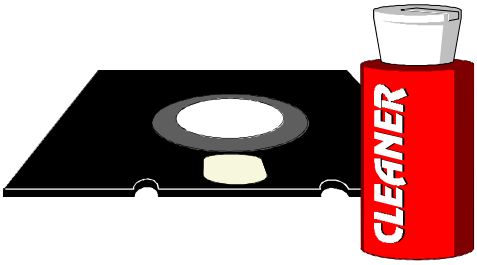
   Submerge the lint-free swabs into the liquid cleaning solution. Then use the soaked foam swab to wipe down the connectors on the boards. On the motherboard, pay special attention to the slot connectors. Be liberal with the liquid; resoak the foam swab repeatedly and really "wash" the connectors. Don't be afraid if some of the liquid drips onto the surface of the motherboard; this solution is entirely safe for the whole board. Allow the solution to wash the dirt off of the gold contacts in the slot connectors. Continue by dousing any other connectors on the board. Clean the keyboard connector, any grounding positions where screws will ground the board to the system chassis, power supply connectors, speaker connectors, battery connectors, and so on.

   On a plug-in board, pay special attention to the edge connector that mates with the slot connector on the motherboard. Touching the gold contacts coats them with oils and debris, which prevents proper contact with the slot connector when the board is installed. Make sure that all finger oils and residue are wiped off of these gold contacts.

3. Use the swab and solution to clean the ends of any ribbon cables or other types of cables or connectors in the system. Clean the floppy drive cables and connectors, the hard disk cables and connectors, and any others that you find. Don't forget to clean off the edge connectors that are directly on the disk drive logic boards as well as the power connectors to the drives.

Cleaning Floppy Drives

Cleaning a floppy drive is simple. You can proceed in two ways. One method is to use one of the simple head-cleaning disks that are available at any computer supply store. These devices are simple to operate and don't require that the system unit be opened for access to the drive itself. The other method is the manual method; you use a cleaning swab with a liquid such as pure alcohol or freon. This method requires that you open the system unit to expose the drive and, in many cases (especially with the earlier full-height drives), also requires that you remove and partially disassemble the drive itself.



The cleaning disks come in two basic styles: those using a liquid that is squirted onto the disk as the cleaning agent and others that are totally dry and rely on the abrasive material on the cleaning disk. Always use a wet system with which the alcohol or freon solutions are applied to the cleaning disk. The dry disks actually can damage the heads if used improperly or too often, but the wet systems are safe to use.

The manual method requires that you gain access to the heads themselves, to swab them off manually with a lint-free foam swab soaked in the alcohol or freon solution. This method requires some level of expertise from the person doing the cleaning, because simply jabbing at the heads incorrectly with a cleaning stick may knock the drive heads out of alignment. You must carefully use an in-and-out motion, lightly swabbing off the heads. No side-to-side motion (relative to the way the heads travel) should be used; this motion can snag a head and knock it out of alignment.

Cleaning the Keyboard

One of the best ways to maintain a keyboard in top condition is periodic cleaning. As preventive maintenance, you should vacuum the keyboard regularly. Or you can use the canned compressed air. Before you dust off the keyboard, turn the keyboard upside down so that particles of dirt and dust that have collected inside fall out rather than simply become rearranged.

On all the keyboards, each individual keycap is removable, which can be handy if one of the keys is sticking or acting erratically. For example, a common problem is a key that doesn't work every time you press it. This problem is usually the result of dirt collecting under the key itself. Simply pull off the keycap with your fingers, or a special tool. After removing the cap, spray compressed air into the space under the cap to dislodge the dirt. Then replace the cap, and check the action of the key.

If you tip a soft drink or cup of coffee into the keyboard, all may not be lost. You should immediately purchase several gallons of purified distilled water. Partially disassemble the keyboard, and use the water to wash the components. If the spilled liquid has dried, let the keyboard soak in some of the water for a while. Then, when you're sure that the keyboard is clean, pour another gallon over it to wash off any residual dirty water. After the unit completely dries, it should be perfectly functional. Make sure that the keyboard is dry before you attempt to operate it, or the components may short out.

Exercise #4 - System Reassembly

1. Referring to your earlier drawing, reassemble your computer.

2. Connect all cables.

3. Turn on your computer. Did it boot normally? _____

Review of Hardware Lessons

1. Connect power cables to motherboard carefully (black on black).
2. Watch for bent pins, cables, etc.
3. Use common sense in how things are connected.
4. Keep system OFF when plugging items in.
5. Watch for connector to floppies reversed.
6. Be careful reseating adapters. Use rocking motion. Use similar care with SIMMs.
7. Maintain documentation of current configuration and frequent backups.

UNIT 3

PROBLEM DIAGNOSIS AND REPAIRS

Most problems are simple. However, it seems sometimes that the simple solutions are often overlooked. If you begin with the obvious, and follow a systematic approach, success is guaranteed.

Objectives

At the conclusion of this unit, the student will be able to:

- analyze a PC problem with a well-developed troubleshooting strategy.
- use various software and hardware tools to determine the nature of PC problems.
- isolate a specific configuration problem.
- swap out individual PC components.

Introduction to Troubleshooting

When you troubleshoot a system, you should approach the task with a clear mind and a relaxed attitude. If you get overexcited or panic, you will make figuring out the problem much more difficult.

Don't start taking apart the system unit right away. First, sit back and think about the problem. Make notes and record any observations. Notes can be valuable, especially for difficult problems. Don't throw away the notes once the problem is solved. These notes can be valuable for a recurring problem. You should develop a systematic approach to determining what the problem is. Here are some basic troubleshooting rules of thumb:

1. Check the installation and configuration. Often, if you just put together a system and it doesn't work properly, it's your own fault. You didn't set a jumper correctly, plugged a cable in backward or left it unplugged, or some other small detail.

2. Check the installation and configuration again! Even when you are sure it's correct, you still may have made mistakes. Double check everything.

3. If you still have a problem, work your way through the system item by item, from those most likely to cause a problem to those least likely to cause a problem. Power supplies often cause problems, for example, so you should check the power supply before many other devices. An improper low-level format can cause hard disk problems, so check that possibility before you assume that the disk is bad.

4. A variation on the preceding rule is to work your way through the system from the simplest, least expensive, and easiest-to-replace item to the most complex, most expensive, and hardest-to-replace item. This is just common sense. Check cables before adapter cards, for example, and check adapter cards before disk drives.

5. Check the environment, including incoming power, ambient temperature fluctuations, humidity, static electricity, and airborne contaminants. Environmental influences can cause many problems, and these problems can be the most difficult to track down. (How can you see temperature or humidity variations?)

6. Keep the documentation and manuals close by. Write your own documentation for your systems and include anything you put into your system. Document the interrupt and DMA channel settings, port usage, memory usage, what slots the adapter cards are installed in, what kinds of memory chips you used in the system, and so forth.

Exercise #5 – Developing a Systematic Approach

The Light Bulb Exercise

You come home from work late. You walk into the living room and flip the light switch to turn on a lamp. Nothing happens.

Diagnose the problem. In the space below, list all of the possible things that could be wrong. After completing your list, prioritize it.

Priority	Possible Problem
____	_____
____	_____
____	_____
____	_____
____	_____
____	_____
____	_____
____	_____
____	_____
____	_____
____	_____
____	_____
____	_____

The Boot Process

turn switch on
⇩
fans start
⇩
drives spin
⇩
ROM BIOS is read
⇩
POST is executed
⇩
drive A is checked for boot record
⇩
drive C is checked for boot record
⇩
master boot record loader is loaded
⇩
partition table is checked for bootable partition
⇩
boot sector loader is located, loaded, & executed
⇩
IBMBIO.COM (IBM)/IO.SYS (MS) and SYSINIT are loaded
⇩
standard devices and drives are set up by SYSINIT
⇩
IBMDOS.COM (IBM)/MSDOS.SYS (MS) are loaded
⇩
CONFIG.SYS (if exists) is processed by SYSINIT
⇩
COMMAND.COM is loaded
⇩
AUTOEXEC.BAT (if exists) is executed
⇩
C:\> is displayed

Diagnostic Software

Computers have several types of diagnostic software procedures available to assist a user in identifying many of the problems that may occur with the computer's components. These programs can do most of the work in determining which PC component is defective. The following three programs are available that can help you locate a problem. Each program is more complex and powerful than the preceding one.

- A POST (power-on self test) that operates whenever a PC is powered up or turned on.
- General diagnostics testing software that uses the diagnostics disk and accompanying problem determination procedures outlined in the operations manual for each system.
- Optional advanced diagnostics testing software and procedures that use the advanced diagnostics disk and procedures provided in the hardware maintenance service manual.

Power-On Self Test (POST)

The POST is a series of program routines buried in the motherboard ROM firmware that tests all the main system components at power-on time. This program series is the cause for the delay after you turn on an IBM-compatible system; the program is executed before the system loads the operating system.

The POST follows the sequence below:

exercises CPU
validates RAM
exercises timer chip
exercises DMA chip
exercises video RAM and controller
checks keyboard
verifies ROM BASIC (IBM)

What Is Tested?

Whenever you start up your computer, it automatically performs a series of tests that check various components in your system. The components tested by this procedure are the primary ones. Items such as the CPU, ROM, motherboard support circuitry, memory, and major peripherals (such as the expansion chassis) are tested. These tests are brief and not very thorough compared with the other disk-based diagnostics that are available. This POST process provides error or warning messages whenever a faulty component is encountered. Two types of messages are provided: audio codes and display screen messages or codes.

POST Errors — What to Listen and Look For

POST error codes usually are audio codes consisting of various beeps that identify the faulty component. If your computer is functioning normally, you hear one short beep when the system starts up. If a problem is detected, a different series of audio codes is sounded. Audio codes and corresponding problem areas are listed below.

On the XT, AT, PS/2, and most compatibles, the POST also displays system memory as it is tested. The last number displayed (640KB OK, for example) is the amount of memory that tested properly. This number should agree with the total amount of memory actually installed in your system, including conventional and extended memory. Expanded memory is not tested by the POST and does not count in the numbers reported.

If an error is detected during the POST procedures, an error message is displayed. These messages usually are in the form of a numeric code several digits long.

Sound	Display	Likely Problem
none	none	power
none	cursor (only)	power
none	DOS prompt	defective speaker
1 short	DOS prompt	normal start up
1 short	BASIC	no boot diskette
1 short/1 long	none	monitor
2 short	blank or garbled	monitor
2 short	error code *	refer to error codes
repeating short	305 error code *	keyboard
repeating short	code other than 305 *	power
continuous	none	power
1 long/1 short	none	system board
1 long/2 short	none	monitor
1 long/3 short	none	monitor

* See reference section for complete list of IBM PC/XT/AT and PS/2 error codes. Although many different manufacturer's error codes are similar, if you are troubleshooting a non-IBM PC, refer to that manufacturer's documentation to prevent a misdiagnosis.

Aftermarket Diagnostics

Many more diagnostics programs are available for IBM and compatible systems. Specific programs are available to test memory, floppy drives, hard disks, video boards, and most other areas of the system as well. Those listed below are some of the best non-IBM diagnostics that are available, some of which should be considered essential in any toolkit.

- CheckIt PRO
- QA Plus
- System Sleuth Professional

A Healthy Configuration

The CONFIG.SYS file contains information about special devices attached to the system. A typical CONFIG.SYS file is displayed below.

```
rem ==========================================
rem      CONFIG.SYS  (January 25, 1993)
rem      -- IBM PS/2 Model 80 '386
rem      -- MSDOS Version 6.2
rem ==========================================
rem ---- LOAD MEMORY MANAGEMENT PROGRAMS
device    = c:\dos\himem.sys
device = c:\dos\emm386.exe
dos = high, umb
rem ---- SET OPTIONS
break = on
buffers = 30,8
files = 40
lastdrive = z
rem ---- INSTALL DEVICE DRIVERS
devicehigh = c:\dos\ansi.sys /x /1
device = c:\dos\smartdrv.sys 4716
devicehigh = c:\dos\ramdrive 4096 /e
device = c:\dos\$fdd5.sys
rem ---- INSTALL MEMORY RESIDENT PROGRAMS
install = c:\dos\fastopen.exe c: d: /x
install = c:\dos\doskey.com
rem ---- SETUP COMMAND PROCESSOR & 400 BYTE ENVIRONMENT
shell = c:\dos\command.com /e:400 /p
```

Individual configuration commands are listed in the reference section in the back of this manual. For additional information on setting up a healthy CONFIG.SYS file to accommodate unique situations, you are advised to enroll in an advanced DOS class.

If you observe an error displayed on the screen while the computer is processing the CONFIG.SYS file, there is probably some type of error or conflict in the CONFIG.SYS file.

The Importance of a Boot Disk

Sometimes an error in CONFIG.SYS can render your PC unbootable. To recover from such situations, you should have a DOS boot disk available.

Exercise #6 - Making a Boot/Rescue disk

1. Insert floppy in drive A.

2. At the DOS prompt (C:\>) type ***format a: /s*** and press ↵.

Adding Other Important Files

In addition to the necessary system files, your rescue disk should contain these DOS programs:

- simple AUTOEXEC.BAT with path statement
- ATTRIB.EXE
- CHKDSK.EXE
- FDISK.EXE
- FORMAT.COM
- MEM.EXE
- MORE.COM
- MOVE.EXE
- RESTORE.EXE
- SETVER.EXE
- SUBST.EXE
- SYS.COM
- UNDELETE.EXE
- XCOPY.EXE
- (DBLSPACE/DRVSPACE.BIN)

Version 5.0 or earlier: EDLIN.EXE
Version 6.0 or later: EDIT.COM and QBASIC.EXE

Exercise #7 - Stepping Through CONFIG.SYS

Troubleshooting errors in the CONFIG.SYS file is very easy using DOS 6.

1. Reboot the computer.

2. When you see "**`Starting MS-DOS...`**" displayed, press F8.
   DOS will prompt you to carry out or bypass each command in the CONFIG.SYS file. When the CONFIG.SYS file is completed, DOS will ask if you want to execute the AUTOEXEC.BAT file.

To skip the entire CONFIG.SYS file, press F5 when you see "**`Starting MS-DOS...`**" displayed.

Swapping Out

Power Supply Problems

A weak or inadequate supply can put a damper on your ideas for system expansion. Some systems are designed with strong power supplies, as if to anticipate a great deal of add-in or expansion components being added to the system. Some systems have inadequate power supplies right from the start, however, and cannot accept the number and types of power-hungry options you may want to add.

For example, the PC's 63.5-watt supply is inadequate for all but the most basic system. Add a graphics board, hard disk, 8087 chip, and 640K of memory, and you will kill the system in no time at all. The total power draw of all the items in the system determines the adequacy of the power supply.

Repairing Floppy Drives

Attitudes about repairing floppy drives have changed over the years. The major reason is the decreasing costs of drives themselves. When drives were more expensive, people often considered repairing them rather than replacing the entire drive. But with the cost of drives decreasing each year, certain repair procedures that are labor or parts intensive actually have become almost as expensive as replacing the drive with a new one.

Because of the cost considerations, repairing floppy drives usually is limited to cleaning the drive and heads and lubricating any of the mechanical mechanisms. On drives that have a speed adjustment, adjusting the speed to be within the proper operating range is also common. Note that most of the newer half-height drives do not have any adjustment for speed. These drives use a circuit that automatically sets the speed at the required level and compensates for variations with a feedback loop. If such an automatic drive is off in speed, the reason usually is that this circuit failed. Replacement of the drive usually is necessary.

Repairing Hard Disk Drives

Repairing hard drives is usually something you cannot do if the problem is really a true "hard" problem. The majority of hard disk problems are of the "soft" type, where a new low-level format and defect mapping session will take care of the problem. These "soft" problems are characterized by a drive that sounds normal but gives various read/write errors. "Hard" problems are those that are mechanical in nature, such as when the drive sounds as though loose marbles are inside the sealed HDA, or you can hear loose parts from the drive—with absolutely no reading or writing capability at all. A low-level format probably will not put those types of drives back into service. In those cases, you will do best to send the drive back to the manufacturer, where the drive can be opened in a clean room environment and repaired properly. Several third-party repair depots also are available that specialize in hard disk drives and have the requisite clean room facilities.

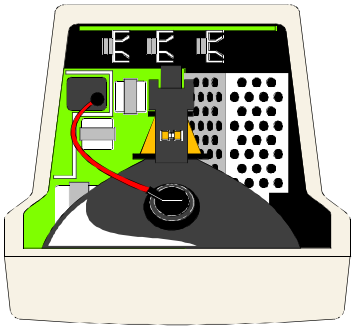
Keyboard Repairs

Most repair operations are usually limited to changing the cable or cleaning some component of the keyboard from the cable contact ends to the key contact points. The cable for a keyboard takes quite a bit of abuse and therefore can easily fail. The cable uses strain reliefs, but you still may have problems with the connectors making proper contact at each end, or even with wires that have broken inside the cable itself. You may want to purchase a spare cable for each type of keyboard you have to maintain. Extra cables provide inexpensive insurance.

All keyboard cables plug into the keyboard and PC with connectors, so you can easily change the cables without splicing wires or soldering any connections. With the earlier 83-key PC and 84-key AT keyboards, you have to open the case to access the connector where the cable attaches. On the newer 101-key Enhanced Keyboards, the cable plugs into the keyboard from the outside of the case, using a modular jack and plug similar to a telephone jack. This design, one of the best features of this new keyboard, also makes the keyboard universally usable on nearly any system except the original PC.

Cleaning the individual keyswitch assemblies, the entire keypad, or the cable contact ends, as well as completely replacing the cable, are the only ways feasible to repair a keyboard. The individual spring and keyswitch assemblies are not available as a separate part, and disassembly of the unit to that level is inadvisable due to the difficulty of reassembly. Besides cleaning, the only things that can be done are to replace the entire keypad assembly (virtually the entire keyboard) or the cable itself.

Troubleshooting Video Problems



The servicing of most graphics adapters and monitors is simple, even though servicing often is left undone. Whether an adapter or display is found to be defective or dysfunctional, it usually is replaced as a single unit. Most of today's cards cost much more to service than to replace, and the documentation required to service the adapters properly is not available.

Servicing displays is slightly different. Although a display often is replaced as a whole unit, many displays are too expensive to replace. Your best bet is to contact the company from whom the display was purchased. Often the manufacturer is the only one who can repair the monitor. If your NEC Multisync XL display goes out, for example, a swap with another monitor can confirm that the display is the problem. After the problem is narrowed down to the display, a call to NEC provides you with the location of the nearest factory repair depot.

You cannot repair this display yourself or even have standard repair shop personnel, such as TV service people, work on the unit. First, opening the case of a color display exposes you to high as 35,000 volts of electricity. *Touching the wrong item can be fatal.* The display circuits can sometimes hold these high voltages for hours, days, or even weeks after the power is shut off. A qualified service person needs to discharge the tube and any power capacitors before proceeding. Second, the required documentation is not available for repairing any of the modern displays. These displays do not have schematic diagrams, board layouts, parts lists, or any of the items necessary for you to properly diagnose the display.

Diagnosing Intermittent Problems

The hardest problem to diagnose is the intermittent problem. Often, you have to rely on a report from a user who cannot describe the symptom accurately. You have to interpret the user's description and guess what really happened. You may think you have fixed the problem only to find that the problem occurs again. Following are some things to try.

- If you can, get the user to write down when the problem occurs and what the exact symptoms are. Before you begin disassembling the system, try to re-create the problem. Once you have witnessed the intermittent problem yourself, run the diagnostics software.

- One of the best resources in the case of an intermittent failure is the advanced diagnostics software. This software can execute a test in an endless loop mode, which can be set to run all night or over a weekend.

- Another weapon commonly used to track down these problems is heat. You can use a hair dryer to warm up the motherboard and other electronics to help the failure along. You must be *very* careful not to do any real damage.

- Sometimes the opposite approach can work too. When a system is exhibiting the problem, you can spray some "component cooler" or freon onto the suspected component, which chills it. If the component's failure is heat related, this chilling often restores its operation.

- Static electricity and other external environmental influences often can cause what appears to be an intermittent problem. Noting the state of the surrounding environment when the problem is occurring is important.

- Pay attention to time. Sometimes strange time patterns can help you discover that a problem is related to an external influence, such as turning on any large motors at the same time each day.

UNIT 4

UPGRADE CONSIDERATIONS

IBM and compatible systems are the easiest systems to upgrade and improve because of the support received from the aftermarket and IBM. Numerous options are available for extending a system in virtually any targeted area. You can extend the life of earlier systems by adding functions and features that match the newest systems on the market.

Objectives

At the conclusion of this unit, the student will be able to:

- install a floppy or hard drive.
- add and configure additional memory.
- discern the relative advantage of upgrading vs. replacing.
- critique advertised systems.

Installing Floppy Disk Drives

The actual procedure for installing floppy drives is simple. You install the drive in two basic phases. The first phase is to configure the drive for the installation, and the second phase is to actually perform the physical installation.

Drive Configuration

Configuring a floppy drive consists of setting the various jumpers and switches mounted on the drive to match the system in which the drive is to be installed, as well as tailoring the function of the drive to that desired by the installer. To set up a specific drive correctly, you must have information from the manufacturer of the drive to know all the options.

Here are the standard options that typically need attention during an installation procedure:

- Drive-select jumper
- Terminating resistor
- Diskette changeline/ready jumper
- Media-sensor jumper

Drive-Select (DS) Jumper

Each drive on a particular cable must be set to have unique drive-select settings. A normal configuration is to set to the first drive-select position the drive you want to respond as the first drive (A:). Set to the second drive-select position the drive you want to be B:. On some drives, the DS jumper positions are labeled 0, 1, 2, and 3, and other drives use the numbers 1, 2, 3, and 4 to indicate the same positions. For some drives, then, a setting of DS0 is drive A; but for others, DS1 indicates drive A. On many drives, the actual jumpers on the drive circuit board are completely unlabeled. You must consult the drive's manual to find out which jumpers are for which settings.

Terminating Resistor

A terminating resistor must be placed (or activated) in the drive plugged into the cable that is the farthest away from the controller. The function of this resistor is to prevent electrical echo on the signal cable. All drives come with this resistor installed. The terminating resistor must be disabled for any drives that are not the farthest away from the controller.

Physical Installation

You must ensure that you have the correct hardware such as screws and brackets for half-height drives before you can install the drive. Also, different faceplate or bezel options are available; make sure that you have the right bezel for your drive. Be sure that the power cable is installed properly. This cable is keyed so that it cannot be plugged in backward. Also install the data and control cable. If no key is in this cable that allows only a correct orientation, use the odd-colored wire in the cable as a guide to the position of pin 1. This position mates with the drive correctly when you plug in the cable so that the odd-colored wire is plugged into the connector toward the notch in the board.

Installing Hard Drives

Here is an outline of the major steps to follow in the installation of a hard disk for any PC, XT, AT, or PS/2 system:

1. Drive configuration
   a. Drive-select jumpers
   b. Terminating resistors
2. Physical installation
3. Machine-to-disk configuration
4. Formatting and software installation
   a. Low-level format
      1. Defect mapping
      2. Interleave selection
   b. Partitioning
   c. High-level format

Drive Configuration

Configuring a hard disk drive is similar to configuring a floppy drive, but it actually is much less complicated. Only two things need to be set: the drive-select jumper and a terminating resistor.

Drive-Select Jumper Setting

The drive-select setting is simple if you have the twisted cable. The drive at the last physical connector on the end of the cable after the twist is drive C, and it is set as the second drive select position (DS1 or DS2). As with floppy drives, the setting of DS1 or DS2 for the second drive depends on whether the first drive setting is labeled DS0 or DS1. The drive plugged into the control cable center connector between the other drive and the controller card is drive D, and it also is set to the second drive select position (DS1 or DS2). If the cable is not twisted, drive C is set to the first drive select position (DS0 or DS1), and drive D is set to the second drive select position (DS1 or DS2).

Terminating Resistors

A terminating resistor must be installed on the drive that is physically the farthest from the controller—in other words, the last one on the daisy chain. In any IBM compatible system, the terminating resistor is installed in drive C. The other drive plugged into the middle of the cable (drive D) must not have a terminating resistor installed.

Physical Installation

The physical installation of a hard disk is much the same as for a floppy drive. You must ensure that you have the correct hardware such as screws and brackets for half-height drives before you can install the drive. Also, different faceplate or bezel options are available; make sure that you have the right bezel for your application.

Machine-To-Disk Configuration

With the drive physically installed, you can begin the configuration of the system to the drive. You have to inform the system about the drive so the system can boot from it when powered on. This information can be set and stored in several ways, depending on the type of system you have.

To begin the setup procedure, you need to know several specific items about your hard disk drive, controllers, and the system ROM BIOS. To continue properly, you should have the OEM manuals for these devices. You need to know these facts about your particular drive:

Number of cylinders
Number of heads
Starting cylinder for write precompensation
Range of acceptable head step pulse timing
Locations of all defects by cylinder and head

All this information, with the exception of the defect list, is in the drive manual. The defect list usually is on a sticker on the top or front of the drive—or possibly on a piece of paper attached to the drive. You must copy and record this information because it is required later for a proper low-level format.

The motherboard ROM contains the available drive types, and the SETUP program is used to select the desired type.

If the system is an AT type, you need the following information about the ROM BIOS:

What are the supported drive type values?
What is the selected head step pulse rate?

Setup Program and Drive Types

For AT types of systems, you set the drive type by looking up your particular drive information in the table of types located in the system ROM.

With the drive tables and actual drive information in hand, you need to find a table entry that matches on heads, cylinders, and the write precompensation starting cylinder. You may not find an exact match on any of these values, which is OK. You can use any type that has fewer actual cylinders and heads indicated than your drive really has, but you cannot use any type that has more.

To select Type 9, you simply boot the Setup or Diagnostics disk that comes with the guide to operations manual and run the SETUP program. Here is where you normally set the date and time, memory, type of video board, and so on. Proceed to the section where you specify the hard disk type and enter 9. Then simply reboot the system. You are done with this procedure.

The installation is completed by performing a low-level format, partitioning, and then finally the regular format with the system switch.

Increasing Memory

Adding memory to a system is one of the more useful upgrades that you can perform. You can add any of the following three types of memory.

- conventional
- extended
- expanded

Optional:

Instructor Demo - How to Add RAM

Upgrading vs. Replacing

In general, we don't recommend upgrading a system if your goal is to significantly boost its performance. A system's overall performance is a function of the interaction between CPU, disk, and video subsystems. Unless you upgrade all subsystems, you usually wind up with a performance bottleneck someplace. But upgrading all subsystems, including sometimes the power supply, often costs more than a brand new, faster system, and performance gains are generally disappointing. Moreover, swapping components requires more expertise than most users possess. Upgrading a system may make sense, however, if due to budgetary constraints your organization will not permit you to buy a new system but will allow upgrades, or if you merely need more disk space or higher video resolution, perhaps for running Windows.

Hard Disk Space

If you need more disk space, the first thing to consider is a disk compression program. These run unobtrusively in the background, where they automatically compress data before writing it to disk and decompress it again as they read it back in. Since compressed data takes up less space, your disk can hold more—typically almost twice as much.

There are some drawbacks to disk compression programs you should be aware of. First, they require RAM—as much as 45KB—which can be a problem if you are already short of RAM. Second, the time they spend manipulating data can significantly slow disk access on systems with slow CPUs. Microsoft does not recommend using DoubleSpace on 286-based or slower machines. (On a 386 or better, the performance hit is negligible.) Third, by adding another layer of complexity to data manipulation, disk compression software increases, if ever so slightly, the risk to your data. To be as safe as possible, you're better off buying another hard disk and not using disk compression software. On the whole, however, compression technology is very safe.

Should you decide to invest in another disk, you have a wide range of options—so many, in fact, that it's impossible to give very specific advice. Adding a second disk is certainly preferable to replacing the first with a bigger one, since you end up with more storage overall, but that is not always practical. For one thing, you need space inside your PC to install a second hard disk. Some models of PS/2 (50 and 70) have only one hard drive bay, so you don't have much choice but to replace the first drive with a larger one, although some vendors may offer other options such as external drives.

The disk controller in many old systems can control two drives. Assuming you have a second drive bay, adding another drive is a matter of figuring out what drive model is compatible with your present controller and connecting it to the second connector. If your system has a SCSI disk controller, you should be able to connect additional SCSI disks to it without any problem. Another option is to add a second controller along with a second hard disk. Still one more possibility for nonMCA systems is Quantum's HardCard, which is a hard disk and controller together on a single adapter board; there is no MCA HardCard option.

To explore your options, talk to some hard disk vendors. Get the largest disk you can afford, because there's no such thing as too much disk storage. Some well-known disk makers are: Conner (1-800-5-CONNER), CMS (714-222-6000), Core (1-800-688-9910), Cumulus (216-464-2211), Maxtor (1-800-4-MAXTOR), Priam (408-434-9300), Procom (1-800-800-8600), and Seagate (1-800-468-3472).

286/386 Processor Upgrades

Plug-in processor replacements are available for 80286- and 80386-based systems and cost between $200 and $500. To the former systems, they bring advanced memory-management capabilities and may or may not make the system run faster. For the latter, they boost performance. Our experience with CPU replacements has been disappointing. By no means does a 386 system with a 486 CPU upgrade run as fast as a true 486 system since the upgrade's design always entails compromises. For example, CPU upgrades usually contain no RAM but instead rely on the RAM already present in the system, which is usually slower than ideal for the processor. The fastest CPU upgrade options consist of an adapter board containing both a processor and fast RAM, with a cable that plugs into the processor socket, but these start at about $1,000. Rarely does the speed boost justify the cost of processor upgrades.

Motherboard Upgrade

Replacing a 286- or 386-based motherboard with a 486 motherboard yields bigger performance gains than processor-only upgrades since it involves fewer compromises. Motherboards are fairly expensive, however—about $500—and do nothing for disk performance. There are virtually no PS/2 motherboard upgrade options.

OverDrive

Nearly all 80486-based systems can be upgraded with the Intel OverDrive processor (about $500). In old systems, the OverDrive replaces the original 486 processor. In newer systems equipped with an OverDrive socket, the chip fits in next to the original processor. The OverDrive doubles the CPU's internal speed; for example, a 486DX/33 system will run at 66MHz. This typically results in up to a 70% performance boost. If you can afford it, the OverDrive is a good way to get peak performance from your 486 system.

Video Upgrades

Most systems sold today come with VGA or better graphics capability either built into the motherboard or on separate adapters; they use multisynch or fixed-frequency analog monitors. Early PCs through the PC-AT had monochrome (MDA), color (CGA), or Enhanced Graphics (EGA) adapters and used multisynch or fixed-frequency digital monitors. Some graphics applications now require at least VGA graphics. Replacing, say, a CGA adapter and monitor with a VGA adapter and multisynch monitor, either to run a certain application or for better image quality, is reasonable. If you run Windows, you might also want to upgrade from a VGA adapter to one that does higher resolution, allowing you to have more applications visible at once.

UNIT 5

TROUBLESHOOTING PAIRS

Objectives

At the conclusion of this unit, the student will be able to:

- determine the cause of and solution to a simulated problem with their PC (with the aid of their partner).

Exercise #8 – Troubleshooting Practicum

1. Turn on your computer. Pay careful attention as it boots.

2. Write down any error messages, sounds, or lack thereof.

3. Using the troubleshooting skills and techniques learned in this class, attempt to identify and correct the suspected problem.

4. Remember, do not panic.

5. After you have fixed the problem, notify the instructor who will prepare you for another problem.

6. Record your observations below.

Problem	Error Messages / Diagnosis / Actions Taken
1	
2	
3	
4	
5	
6	
7	
8	

REFERENCE

POST Error Codes

01x System failure, undetermined cause. Usually a fatal error of the system board.

02x System failure, most likely related to the power supply.

1xx System board failure.

102 ROM BIOS error. May require replacement of ROM BIOS.

103 CHECKSUM ROM error.

16x System options or configuration error.

161 Error in system configuration information. Suspect CMOS RAM or battery back-up failure. It will be necessary to run the system configuration program.

162 Error in system configuration information. Suspect CMOS RAM or battery back-up failure. It will be necessary to run the system configuration program.

163 Time and date not set, or time and date information has been lost.

164 System memory found during start up does not match configured system memory.

199 Reminder error that some installed device is incorrect.

2xx RAM memory failure. This is a failure of on-board memory.

3xx Keyboard failure.

301 Keyboard failure. This is most likely a stuck key or keyboard not connected.

4xx Monochrome monitor failure.

401 Monitor failure, most likely the interface card.

432 This error may be caused by a parallel printer that is attached but not turned on.

5xx Color (CGA) monitor failure.

501 Color monitor failure, most likely the interface card.

6xx 5.25 floppy drive failure.

601 Floppy drive or controller failure. Drive or controller not responding.

606 Change line (drive heads closed) test failure.

7xx Math coprocessor. You may receive this error if the system is configured for a coprocessor but none is installed.

9xx Primary parallel port failure.

10xx Alternate parallel port failure.

11xx Primary asynchronous (serial port) failure.

1101 May occur if an external modem is attached and turned on during start up.

12xx Alternate asynchronous (serial port) failure.

13xx Game controller interface failure.

14xx General printer error.

17xx Fixed disk error codes.

1701 Drive not ready, or fatal drive or controller error.
You will receive this error if you forget to turn on an external hard disk.

1702 General hard disk or controller error. It's as likely one as the other.

1703 General hard disk or controller error. It's as likely one as the other.

1704 General hard disk or controller error. It's as likely one as the other.

18xx PC/XT I/O expansion unit failure.

2401 EGA or VGA or controller failure.

2501 EGA or VGA or controller failure.

48xx IBM internal modem failure.

73xx 3.5 floppy drive or controller failure.

7301 Drive or controller test failure.

7306 Drive change line (disk inserted) test error.

Configuration File Commands

- **BREAK**=[on | off] (default=off)
  You can press Ctrl+C to stop a program or an activity. DOS only checks for Ctrl+C while it reads from the keyboard or writes to the screen or printer. When set to ON, the frequency with which DOS checks for Ctrl+C from the keyboard is dramatically increased; can be particularly useful in catching loops in non-I/O intensive programs.

- **BUFFERS**=n[,m] (n=1-99, m[secondary cache]=1-8)
  Buffers control a small disk cache DOS uses to speed up disk access. DOS uses the memory reserved for each disk buffer to hold data during read and write operations. Each buffer requires approximately 534 bytes of RAM. Therefore the more buffers you have, the less memory you have available for programs. The best way to determine the optimal number of buffers for your system is trial and error but there are some guidelines based on hard disk size (and number of subdirectories):

Up to 40 MB - 20 buffers	Greater than 80 MB - 40 buffers
Greater than 40 MB - 30 buffers	Greater than 120 MB - 50 buffers

- **COUNTRY**=xxx (xxx=three digit code, default=001 U.S.)
  Defines to DOS which format to use in displaying dates, currency, and decimals. Some examples: 033 is France, 044 is UK, 046 is Sweden, 055 is Brazil, etc.

- **DEVICE**=[drive:][path]filename [device driver parameters]
  Instructs DOS to load an additional assembly language file which provides information on how to handle the interface to a given peripheral. This device "driver" becomes an integral part of the BIOS. You can use as many devices as you require (e.g., ANSI.SYS, SMARTDRV.SYS).

- **DEVICEHIGH**=[drive:][path]filename [device driver parameters]
  Specialized version of DEVICE= command. When used in conjunction with 386 memory managers, it allows programs to be loaded into upper memory.

DOS Devices:	Function:
ANSI.SYS	Enhanced screen and keyboard control.
DISPLAY.SYS	Provides support for hardware code pages on certain displays.
DBLSPACE.SYS	Creates compressed drives.
DRIVER.SYS	Creates "logical" floppy drives.
EGA.SYS	Provides EGA display support for Windows and DOSSHELL.
EMM386.SYS	Used to simulate expanded memory (EMS) in extended memory or create upper memory blocks without EMS .
HIMEM.SYS	Manages the use of extended memory (XMS) and allows access to high memory area (HMA).
PRINTER.SYS	Controls IBM printers and code pages (discontinued in 6).
RAMDRIVE.SYS	Controls RAM or virtual (imaginary) drives.
SETVER.SYS	DOS version fooling utility, sets the version number that DOS reports to a program.
SMARTDRV.SYS	Disk caching software (exe in 6).

- **DOS**=high|low [,umb|noumb]
  Sets the area of RAM where DOS will be located, HMA or conventional. When umb is specified, DOS prepares upper memory for DEVICEHIGH and LOADHIGH commands.

- **DRIVPARM**=/d:number[/c][/f:factor][/h:heads][/i][/n][/s:sectors][/t:tracks]
  Modifies the parameters (characteristics) of an existing physical drive.

- **FCBS**=x (x=1-255)
  Allows you to specify the number of File Control Blocks (FCBs) that DOS can have open at one time. Most newer programs do not require FCBs.

- **FILES**=x (x=8-255, default=8)
  Specifies the maximum number of files that DOS can access at once. The number may be increased to handle error conditions. A typical setting is 20.

- **INSTALL**=[drive:][path][FASTOPEN|SHARE|KEYB|NLSFUNC].EXE
  Used to load a TSR (terminate and stay resident) program while DOS reads the config file. (FASTOPEN tells DOS how many files to keep track of; SHARE is used when you're on a network; KEYB and NLSFUNC are used for changing international settings.)

- **LASTDRIVE**=x (x=A-Z, default=the one after the last drive on your computer)
  Specifies the last valid drive letter that DOS is to recognize. The minimum number you can set is the number of drives you have installed on your computer.

- **NUMLOCK**=off
  Turns Num Lock off on startup automatically.

- **REM** [any text]
  Allows you to add program comments/remarks. Any text that follows the REM command and a space will be ignored by DOS. (; can be used instead of REM in 6.)

- **SET** [variable=[string]]
  Displays, sets, or removes DOS environment variables.

- **SHELL**=[drive:][path]filename [command.com parameters]
  Specifies an alternative command processor to COMMAND.COM for loading the operating system. Preferred method for increasing the environment size to 512 bytes.

- **STACKS**=n,s (n=number, s=size in bytes)
  Supports the dynamic use of data stacks to handle hardware interrupts. Default setting is 9,128 which wastes 1,125 bytes.

- **SWITCHES=**/k
  Forces an enhanced (101 key) keyboard to behave like a standard (84 key) keyboard.

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